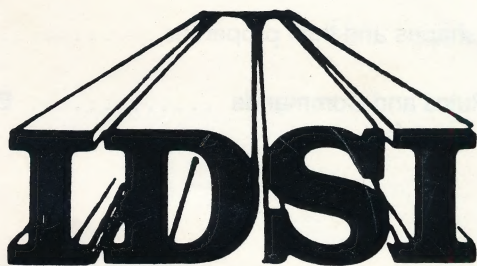# SURVIVAL

OF

THE FITTEST

© 1982, Mark Gaponoff

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GAME MANUAL TABLE OF CONTENTS

SURVIVAL OF THE FITTEST
a game of "life"
© 1982, Mark Gaponoff

1. INTRODUCTION

Survival of the Fittest is a game of strategic and tactical skill for 1 or 2 players that is designed to run on Atari (*) 400 and 800 model microcomputers. It is a ROM cartridge game for the 400 ROM slot or the LEFT 800 ROM slot, plus two joysticks (with trigger buttons) plugged into jacks 1 & 2.

Survival of the Fittest is very different from other computer games, it is primarily a contest between 2 players, with the computer being the "playing pieces" and the "board", much like an animated chess game. (See Appendix A for playing single-handed). It is a game that will continue to fascinate you for a long time.

Survival of the Fittest pits two player's "species" of "cells" against each other, where each species vies for control of the "universe" (the playing field). The object is to be the side that most successfully populates the universe with their species of cells. There is a large element of subtlety and skill in the playing of this game, where study and practice will greatly improve one's ability to win. Like chess or go, this game requires time and effort in order to become adept, but it provides the same satisfaction of intellectual challenge that these classic games provide. Most important, it is fun!

Survival of the Fittest is based on the game of "Life", an algorithm for "cellular atomata" developed by the mathematician John Conway, and popularized by articles in Scientific American, and more recently in other magazines such as Byte. Survival of the Fittest uses the "rules of the universe" of John Conway's "Life" and extends them with added rules, joystick control, and vivid color and sound effects.

This manual is designed to help you learn how to play. Players new to the game should read and follow Chapter 2 (The First Time Through), which takes about 5 minutes. Chapters 3-5 and the Appendices will help to improve your skill and understanding, and explain the various options available.

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2. THE FIRST TIME THROUGH

2.1 Study Mode

This section is intended as a tutorial for players new to the game. Survival of the Fittest is not hard to play, but it does take a little explaining. This section is intended to be a relatively painless introduction to the game.

To play, you need an Atari model 400 or 800 computer, 2 joysticks, and a Survival of the Fittest game cartridge. Insert the cartridge into the LEFT cartridge slot if you have a model

800, or into the single slot of the 400. Make sure the power switch is off, and your TV is on and connected, and close the cartridge slot cover door and turn the power switch on. The "fanfare" for the game should begin immediately.

After the name of the game appears, you will see it "get weird", with funny shapes and odd music. You will notice successive "waves of change" move through the screen from top to bottom. Each "wave" is a new "generation", and each of the little spots on the screen (called "cells") will change with each "generation" according to the "Laws of the Universe" (see section 4.1), which depend on the status of the neighbors of each cell. You and your opponent will be creating shapes (called "life-forms") which will grow, shrink, stagnate, travel, live and die according to these "laws of the universe". You also notice there are 2 colors. One player will be one color, and that player's opponent will be the other color. The winner will be the player most successful in colonizing the "universe" with their color ("species"). After a couple minutes, the fanfare will automatically start over. Push the START key when you are ready to begin.

As you press the START key, the "fanfare" will stop, and the screen will be set up for the "Study Mode", and the "Norm" (normal) option. (Other games and options are available by pressing the "Select" or "Option" keys, but for now let us assume you are playing the "Study Mode", "Norm" option.)

You will notice that the screen has some numbers across the bottom and two flickering bright spots, one on each side of the screen. Take joystick #1 (setting in your hand so that the word "TOP" is away from you) and push the lever away from you. You will see the spot on the left move towards the top of the screen. When it reaches the top, it stays there. If you pull the lever towards you, the spot (known as the "cursor") will move down, and if you move the lever to the left or right, the cursor will do like wise. Take joystick #2 and move the other cursor around a bit also. To move just a little bit, just tap the joystick in that direction.

Now take joystick #1 and press the trigger button once, then move the cursor away a little. You see the pink spot? You have planted a "cell". You may have noticed that the sound has changed, and the numbers along the bottom of the screen are different too. These numbers are:

0 0 0 1	98	0 0 0 0	99	0 0 0 0
left	left	generation	right	right
score	seeds	count	seeds	score

Thus, you have used up one of the left seeds, and have a score of 1. Next, hold down the trigger and move the cursor around with the joystick. You are drawing lines of cells! You could write your name if you wished.

Now put down joystick #1 and pick up joystick #2. Move to an empty area of the screen and press the trigger, and move away. A green cell! The right side now has a score of 1. Now move the cursor back so it is exactly on that single cell, and press the trigger. Nothing Happens! The game will not let you plant a cell on top of one of your own cells already there. Press the trigger a second time. It's gone! If you press the tigger twice on a given spot before moving away, you can "erase" a cell.

2

Now move the cursor on top of some pink cells and press the trigger. You can plant seeds over your opponent's cells! This is getting fun, but where's the action?

To "start up" the universe you have seeded, press the [space bar]. Wow. The shapes you drew are evolving according to the rules of "life". Now press the [space bar] again. The action is halted. Press agian and evolution begins again, press yet again and you are again halted. The [space bar] is a start-stop control.

While you are halted, you may plant more seeds with either joystick. Now press the [space bar] to again start up evolution and move one of the cursors to an empty area of the universe and press the trigger. A single cell is "zapped" into that spot. In the rules of life, each cell must have 2 or 3 neighbors to survive, so a lone cell out in the middle of nowhere will not survive to the next generation. Hold the trigger down on the joystick and you will see one new cell "zapped" into that spot each generation, but since each one is alone, they die. While things are "evolving" (called the "play" phase) each player may plant seeds only once per generation. Now move the cursor right next to a stable shape (a group of cells that doesn't change from generation to generation), and press the trigger. The single cell you planted will "disrupt" that shape, causing it to grow or shrink into another shape, or even disappear entirely! Where and how to plant seeds dynamically are the tactical manuevers of importance in Survival of the Fittest.

2.2 Console Commands -- Changing Games

After you have had fun zapping shapes on the screen, push START. The screen will erase, and you will be ready to start another round of Study Mode. But there are two other games. To select another game, press the SELECT key. You will see an empty playfield with a line running up and down the middle, and "ONE SEED GAME" (the new game selection) in bright yellow letters along the bottom left of the screen, and "NORM" (the current play option) in dark letters along the bottom right. Press SELECT again, and now there is a row of colored shapes above the game name at the bottom of the screen, and this game is called "SEED LIST GAME". Press SELECT once more, and the row of shapes, and the border disapears, and we are back in "STUDY MODE", where we started. Thus there are 3 game selections in Survival of the Fittest.

Now turn your attention to the OPTION key. Press it once and "HCAP" will appear in the lover right corner. The game selection will not change, just the option. Press OPTION several more times to look at all 6 option choices, NORM, HCAP, WALL, FAST, WILD, and SLOW. Each option is a different variation on the basic game. Chapter 3 describes the various game selections and play options in detail.

When the desired option has been found, the START key starts it up, but don't press it yet. Press the SELECT and OPTION keys until you have the "SEED LIST GAME" and "SLOW" option selected. Get your opponent and each of you hold one joystick.

2.3 Seed List Game -- The first time through

Before we begin, examine the screen. The playfield is divided by a vertical border in the middle, and there is a line of "shapes" along the bottom, with the left and right halves of dif-

ferent colors (and mirror-images of each other. The left list (and color) belongs to the player holding joystick #1, and the right list (and color) belongs to the player with joystick #2. This line of shapes is a "menu" of seed shapes that each player will use to propogate his/her "species" in the universe. You will be able to plant whole shapes at once, as well as just single cells!

Set-up Phase

To begin the game, press the "START" switch on the right side of the Atari keyboard. The game name and option will be replaced by a row of numbers. As mentioned before, these numbers are:

0 0 0 0	99	0 0 0 0	99	0 0 0 0
left	left	generation	right	right
score	seeds	count	seeds	score

The score is the number of cells of the species currently "alive" in the universe. The "seeds" number is the number of seed cells remaining for that player. Note that both players start with 99 seed cells. The Generation count is the number of generations (turns) that have passed since the game began.

You will also notice a bright yellow bar across the center border at the bottom that is moving up the center. That bar is the "shot clock", and is timer for both the "set-up" phase of the game and the "play" portion. At the start of the game, the "shot clock" (yellow bar) moves up. This is the "set-up" phase of the game. During this time, you may "plant" as many of your quota of 99 seeds as you wish in whatever configuration you feel will be the most "productive" or "fertile". When the "shot clock" reaches the top, the "play" phase begins (described below).

As you watch the "shot clock" count up, you will also notice a bright flickering spot in the middle of each half of the screen. If you press the joystick handle one way or the other, you will notice that the spot will move in the direction you have pushed. This is your "cursor", and it is used to point to where you wish to plant a seed. You plant a seed by pressing the trigger button on your joystick. There it is on the screen! You may draw a line by holding down on the trigger and moving the joystick.

If the shot clock has reached the top while you are reading this and trying it out for the first time, press "START" and the game will begin again.

You probably have noticed by now that you cannot move your cursor to the bottom of the screen, LET GO, and then push again towards the bottom. Your cursor will "pop" into the "menu" shape below, and one of the shapes will flicker. You may select a shape by moving left or right in the "menu" area. If you press the trigger while in "menu" area, the seed shape you are pointing to will rotate or flip. Thus you can "aim" the seed shape as you wish. After you have selected your new shape, move the joystick "up", and the new cursor will "pop" out into the playfield. Each time you press the triggfer, that shape will be "planted", as long as you have enough seed cells left to form it. Each shape has differnt properties and uses a number of seeds each time it is used. *See section of seed list shapes, Appendix C.*

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Play Phase

After the shot clock reaches the top, the play phase begins. The rules of the universe will operate on the seed shapes you and your opponent have planted, and cause them to grow or shrink according to their shape. With each generation, the generation counter will be incremented, and the new scores for each player displayed, and the "shot clock" will move down a notch. You may continue to add seed cells, but only one seed shape per generation. Seed shapes are added at the END of the generation currently being calculated, thus there may be a lag between the time the trigger is pushed, and when the seed shape is actually "planted". Whenever either player adds a seed shape, the "shot clock" is reset to the top of the screen.

Every time you plant a seed shape, you use up one or more seed cells, depending on which seed shape you use. The shapes vary from 1 to 10 cells each. If you do not have enough seeds left to make up the shape you are attempting to plant, you will not be allowed to plant it. You must carefully ration your limited number of seeds in order to emerge victorious.

Winning

The game ends when one of the following is true:

1) One side has NO live cells on the playfield. The other side instantly wins. Unused seed cells don't count. This manner of winning is called a "shut-out".

2) The shot clock reaches the bottom. The player with the highest score (population) wins. Unused seed cells don't count. (Eventually seed cells are exhausted, and neither player can or will "fire" more seed cells and reset the shot clock, which then runs out.)

3) One side resigns.

In any case (except resignation), the winning side will flash. Ties are allowed, in which case both sides will flash. The [ESC] key permit a continuation after a game ends *see keyboard commands*.

The object of the game is to use your quota of seed cells to populate your half of the universe, "infect" your opponent's half, and defend against incursions by your opponent in such a way as to have the highest score at the end of the game.

Now press OPTION to select the "NORM" option which will move along a bit faster, and play another game. You now know how to play Survival of the Fittest! The more you play and study, the better you'll get, and the better you get, the more fun you will have! The following chapters describe the many fascinating features of Survival of the Fittest.

3. GAME SELECTIONS, OPTIONS, AND KEYBOARD COMMANDS

This section describes the various options and commands available, and how to use them. There are 2 general categories, Console Commands (game or option selection) and Keyboard Commands.

3.1 Console Commands

The four console keys on the right side of the keyboard are all used, and have the following effects: *Note that all 4 keys will wipe out the current game being played*

SYSTEM RESET: Start up system from scratch, replaying the "fanfare". Any previous game is lost.

START: Starts up the current game/option selection. Clears screen, sets generation counter to zero, and sets seed quotas. Single-cell cursors are started in the center of each half of the screen, and the shot clock starts moving up from the bottom (except for Study Mode).

SELECT: Selects the next game option. There are 3 game selections, each of which has a differnet playfield appearance. Pressing the SELECT key clears the current screen (and game) and sets up a new screen with the game/option selection listed along the bottom. The game selection appears on the left bottom in bright print, and the following 3 games are available:

1. Study Mode: This is the default game that appears after the fanfare. The Study Mode has no shot clock, no central border, single cell cursor only. This is used for studying the properties of "life" shapes, for kinetic art (2-color drawing board), or for playing with children or alone (see Appendix A). There is no limit on seeds cells. The seed counter will go down to zero and then wrap around to 99. This is a non-competitive, no pressure mode with which you may explore the properties of "life". since there is no shot clock, the play mode will not start automatically, so there is no shot clock, the play mode will not start automatically, so you MUST use the [RETURN] or [SPACE BAR] keys to start or stop the game. Remember to push the [SPACE BAR] or [RETURN] to start play after you have entered your seed patterns, NOT the START key (the START key will erase the current game and start from scratch!) Also, in Study Mode, there is no "winner", the generations of "life" will continue until you stop them, since there is no shot clock to signal the game end. Note also that both player's cursors can be moved anywhere in the play area.

2. One Seed Game: A competitive 2-player game, with a central border, a shot clock, and uses the single cell cursor only. The game begins in the "set-up" mode, with the shot clock counting up. When the shot clock reaches the top, play begins, until one of the 2 players wins. The set-up phase is especially important in this game, since only the single cell cursor is available. Once the play phase begins, you may only plant one cell per generation, and single cells out in the middle of an empty area have no neighbors, and will die. Thus it is only possible to plant new seeds successfully near groups that are already there, i.e., you must "work off of" your or your opponents groups on your side of the border. Of course, you may not move your cursor or plant cells on the other side of the border. This is the most difficult of the games to play well.

3. Seed List Game: This game is like the One Seed Game, with the additional feature of the seed shape list, a "menu" of seed shapes which can be used in play. This game has a shot clock, and a central border, and is a 2-player contest. At the start of the game, the cursor is the single cell, but other shapes may be "picked up" from the menu at the bottom of the screen. The shapes may be rotated and flipped by pressing the trigger wild in the menu area.

OPTION: Selects the play option for a game. There are 6 options, and the option currently selected appears in dark print on the right side of the bottom. The options mainly affect the game speed and the size of the seed quota for each player. Like the SELECT key, the OPTION key clears the screen and sets up a new game. The 6 options are:

1. Norm: Normal speed, 99 seed cells per player. This is the default option that is automatically picked after the fanfare.

2. Hcap: Handicap option. Like the Norm option, except each player enters the seed quota he/she wishes, any number between 0 and 99. If you are foolish enough to attempt to play with less than 10 seed cells, enter a leading zero, e.g., 08). The left player enters his/her quota first, then the right player. This allows players of different levels of skills to play a more even game. The more experienced player should have a smaller quota of seed cells than the less experienced player. This is the option used for "tournament" play, with each player having about 20-40 seeds each, for the most exciting game.

3. Wall: Like Norm option, except that the universe does not wrap around the edges of the screen. When a life-form encounters the edge, no live cells form beyond it. The edge has some interesting properties, and has an effect on strategy, e.g., you don't have to guard your rear.

4. Fast: Faster shot clock, and only 50 seed cells per side. Used for short, quick games.

5. Wild: Like Fast option, except for occasional random "divine intervention". When this happens, everything flashes wildly, and all your live shapes may be drastically altered. This is four those who like an element of chance.

6. Slow: Longer set-up time, and slower computation of generations. 99 seeds per side. For beginners, or studying the changing patterns of "life" at leisure.

3.2   KEYBOARD COMMANDS

Some of the keyboard keys have functions defined for them as described below:
* [Atari trademark key]:   Changes screen colors.

Each time this key is pressed the screen colors will change to a new set of colors. Thus you may select a color scheme to math your taste of decor! There is a cycle of 32 combinations, the first 16 are "set" and the second 16 color combinations are "random". Many of the random color combinations will not be useable, so you will need to choose another. Random combinations will also change if you start a new game. The screen color change key will work at any time (except for fanfare). After 32 combinations, the cycle starts over with the first set of colors. See also Appendix A.

[SPACE BAR]:   Game halt/resume key.

This key both starts and stops play. If play is in progress, the game will be halted at the end of the generation currently being computed. The game will be in "halt" mode, which is like set-up, except that the shot clock is frozen. You may, if you wish, add seeds to the universe, but if you are playing a competitive One Cell Game or Seed List Game, this would be cheating. Thus a game may be suspended if there is an outside interruption. The game will wait indefinitely for you to resume it. The [space bar] is also used to resume a game that has been halted. Thus the [space bar] can start and stop the play. Note that in Study Mode you MUST use the [space bar] to start and play, since there is

no shot clock to start things up automatically. Also, if you hit the [space bar] during the "set-up" phase of either the One Cell Game or the Seed List Game (while the shot clock is going UP), play will begin immediately.

[RETURN]:   Single-step halt/resume key.

The [RETURN] key acts very much like the [SPACE BAR] in halting the game, but if pressed while the game is halted, acts differently. If pressed while halted, the game will play for only 1 generartion, and then stop, returning to the halted mode. Thus this key may be used to "step through" a life pattern one generation at a time to permit study.

[ESC]:   Game continuation key.

This key only functions at the end of a game, while the winner flashes. It permits "another round" restarting play without erasing the live cells in the universe. Both players have their original seed quotas restored, and a new "set-up" mode begins (with shot clock counting up). In the Seed List Game, each player starts with the last cursor used, but it is started in the center of each player's side.

Number keys (1,2,3,4,5,6,7,8,9,0,):   Seed handicap entry.

In the HCAP (handicap) option only, each player enters his/her number of seed cells at the start of the game. First the player on the left enters 2 digits (which will over-write the question marks on the bottom of the screen, and match that player's color), then the player on the right enters 2 digits. The set-up phase then begins immediately, with each player having between 0 and 99 seeds, with the stronger player hopefully having fewer seeds. If you make an error entering a number, push the START key and enter both player's numbers again.

4.   RULES

The rules of Survival of the Fittest consist of the "Laws of the Universe", which control the birth, survival, and death of cells on the playfield, and the "Laws of Play", which describes the rules of player interaction with the universe. The "Laws of the Universe" are further divided into John Conway's original algorithm, and the extensions added to permit 2 species (and hence competition!). The "Laws of Play" are divided into various game options.

4.1 Rules of Life

The "universe" is a grid of squares (cells) that have 2 basic states, "alive" (lit up) or "dead" (not lit up). Each cell has 8 neighbors:

```
1 2 3
4 X 5
6 7 8
```

The above cell X has 8 neighboring cells. What happens to cells is computed in cycles (called "generations"), and birth, survival, and death of a given cell is dependent on how many of its 8 neighbors are "alive", according to the following 2 rules:

Rule 1:   If a given LIVE cell has 2 or 3 neighbors, it will survive into the next generation. Otherwise, it dies (either "starves to death", or gets "smothered").

Rule 2:   If an empty (dead) cell has EXACTLY 3 live neighbors, a new live cell is created (born) in the next generation.

The universe is "seeded" with live cells, and then successive generations are computed, and the fate of the seed shape is determined.

2 species of live cells may exist in the universe, and they compete against each other and the "laws of nature" for dominance. The above rules apply regardless of the species, i.e., the number of neighbors is the total of BOTH species. A cell remains the species it was "born" as. The species of new cells is decided as follows:

Rule 3:   The species of a new cell is determined by which of the 3 "parent" cells is the majority.

Note that the universe "wraps around" (unless the "WALL" option has been selected--no wrap-around if so), i.e., shapes that grow past the right edge come in on the left edge (and vice-versa), and shapes that grow out the top come in on the bottom (and vice-versa). The size of the Universe is 160 by 88 cells for the Seed List Game, and 160 by 96 cells for both the One Cell Game and the Study Mode.

Each of the 2 species is "seeded" by its player with joystick controls.

4.3   Game Rules

There are 2 parts to each game, the "set-up" (static) mode, and the "play" (dynamic) mode. The set-up mode allows each player to create a starting configuration of cells, especially custom shapes built with the single-cell cursor. The set-up mode lasts only while the shot clock moves upward along the border. Only during set-up can cells be erased (by pressing trigger twice without moving joystick). Erased cells will be "credited" back to the seed quota.

As soon as the shot clock reaches the top (or when the [SPACE BAR] is pressed in Study Mode) the "play" phase begins. Seed cells may still be added, but only one seed shape per generation. Each time either player adds a seed shape, the shot clock is reset to the top of the screen.

If a player does not have enough seeds left to form the seed shape (Seed List Game), that player will not be able to plant that shape. Note that if the seed shape cursor overlaps some of the player's live cells in such a way as to reduce the net amount of seed cells needed (remember that individual seed cells will be placed over that player's live cells), the seed shape may be planted. As an example, say that player #1 has only 2 seed cells left and currently has the "glider" cursor active. If the 3-cell-long bar of the glider is placed over a "blinker" (oscillating 3-in-a-row shape) and the trigger is pressed at the right time, the seed shape will be planted, since it took only 2 seed cells to complete the shape. This would not work if the "blinker" was made up of player #2's cells, since 3 more cells of #1 would have been needed to overwrite #2's cells. See below:
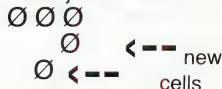
This cursor shape:	Over these live cells:	Needs just 2 seeds.
Ø Ø Ø	Ø Ø Ø	Ø Ø Ø
Ø		Ø **‹ ▬ ▬** new
Ø		Ø **‹ ▬ ▬** cells

Bonus: If the population of either player becomes 1000 or more in any generation, then that player is awarded 1 additional seed cell. One cell is awarded for EVERY generation where that player's population (score) is 1000 or more. Bonus cells will continue to be awarded as long as that player has less than 99 seeds left.

Although it is possible to halt the One Cell Game or the Seed List Game with the [SPACE BAR] or [RETURN] keys, this should not be done in competition unless an outside interruption demands it. When a game is thus halted, it is possible to add seeds as in the set-up mode but this would be cheating in a competitive game.

The game continuation key [ESC] allows players to play several "rounds" of a game it they wish. The number of rounds should either be agreed on beforehand, or a "double-or-nothing" situation can be used.

The computation time for a generation is roughly proportionate to the number of cells in the universe, thus the cycle time for a generation can vary considerably. It can take almost a second for a very full universe, of less than 1/10th of a second for a nearly empty universe. Thus the pace of the game speeds up then there are few live cells in the playfield.

Note also that when moving the cursor a long distance, it moves faster the longer you keep moving, and return to slow speed when you let go or plant a seed shape.

5. STRATEGY AND TACTICS

5.1 Strategy
Briefly, don't use all your seeds during set-up, so you may defend against your opponent's incursions, revive your shapes, and buy time on the shot clock.

A given group of active cells at first may expand, but eventually all shapes tend to "simmer down" into stable or resonant shapes, so you must also pace the "life cycles" of your active areas so that you remain strong as the game progresses. Since there is a lag time between the last seed-planting and the shot clock counting down to the bottom, it is possible for a big lead to be reversed if one side's shapes are degenerating and the other side's are growing.

5.2 Tactics
Tactically, many common shapes can be destroyed, or conversely, made to grow, by a properly placed "perturbation" seed or seed shape near it. Remember that a single seed cell in the middle of nowhere has no neighbors and will disappear in the next generation. Try placing single seeds in various spots near common stable shapes and see how they behave. The combinations that work the best will be your most powerful "moves" in the play of the game.

As an example, place the game in STUDY MODE and try these problems. First let's look at the "block", a stable figure of 4 cells. Each live cell has 3 neighbors, and no nearby empty cell has exactly 3 neighbors, so this shape will not change unless disturbed. There are many ways to "perturb" this shape by adding a single cell, but where the cell is added can have quite different results depending on where it is planted. The following spaces around a block will change in the following manner if a single cell is placed in that spot (letter is result

type, Ø = original block shape):

```
  a  b  b  a
a  c  a  a  c  a
b  a  Ø  Ø  a  b
b  a  Ø  Ø  a  b
a  c  a  a  c  a
  a  b  b  a
```

where a seed planted at one of the "a" points will result in destruction of the entire formation in a few generations; a seed at a "b" point will turn into a "beehive" stable formation of 6 cells; a seed at a "c" point will turn into a "boat" stable formation of 5 cells. Try these points out for yourself. Note that planting a cell further from the block, in an unlettered space, will have no effect on the block.

Similarly, we can examine the consequences of planting a cell near a "blinker", a reson-ant shape of 3 cells:

```
a  b  c  b  a
b  a  c  a  b
a  Ø  Ø  Ø  a
b  a  c  a  b
a  b  c  b  a
```

where "a" spots became "behives", "b" spots destruct, and "c" spots grow into a "traffic sig-nal", a resonant figure made of 4 blinkers! Note that you must carefully time when you push the trigger to plant the seed. New seeds are planted at the END of the current generation, so you must take into account whether the "wave of change" for the current generation has passed over the area of your cursor in deciding when and where to plant a seed. It is thus a little easier to plant cells correctly near the top of the screen than near the bottom.

You should explore the other common stable shapes and see how to perturb them to you advantage. A good one to study is the "beehive", there are only 3 types of single-cell pertur-bations to this figure. It is a worthwhile exercise to explore them...

```
    Ø
Ø       Ø
Ø       Ø           a "beehive" stable shape
    Ø
```

Another important aspect of tactics is defense. You may have noticed that the insertion of a single cell can destroy a group of cell. Thus you can, if you hit things just right, destroy an "invading" formation. Be careful, though, because if you put the disrupting seed in the wrong spot, you may spur your opponent's formation into runaway growth!

## Appendix: A: PLAYING ALONE OR WITH CHILDREN
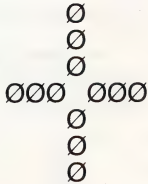
Single-handed play is pretty much limited to the STUDY MODE, and you can even play this option if yu have but one joystick. You can see how shapes survive against the "Laws of Nature". You can use this mode also for "kinetic art", especially with the "WILD" option, which seems to be able to keep a screenfull of cells changing almost indefinitely.

Younger children can have trouble appreciating the subtleties of tactics and the meaning of the shot clock, but in STUDY MODE, they have fun drawing things and watching them "get weird". Drawing letters and names are very entertaining, especially when they start changing.
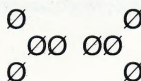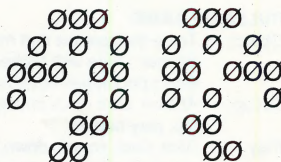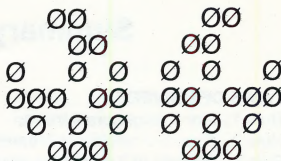
Appendix B: "LIFE" BIBLIOGRAPHY

John Conway's game of "life" was popularized by a series of notices in Martin Gardner's "Mathematical Games" column in SCIENTIFIC AMERICAN, the first one was in the Oct. 1970 issue, and there was some mention in almost every issue for the next year or so. BYTE Magazine's Dec. 1978 issue was especially devoted to "life", with several watershed articles, and the Jan. 1979 issue had some excellant follow up notes. Many other computer magazines have occasional notes on "life".
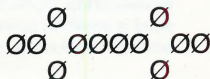
Appendix C: SEED PATTERN PROPERTIES

Seed shape:	Description:	Becomes:
Ø	Single cell.	*Dies if alone*

ØØØ	"Blinker". Resonates between 2 states.	ØØØ & Ø / Ø / Ø

Ø / ØØ	Becomes "Block" stable shape in 1 generation.	ØØ / ØØ

ØØ / ØØ	Becomes "Beehive" stable shape in 2 generations.	Ø Ø Ø / Ø Ø Ø

Ø / ØØØ	Becomes "Traffic signal" 2-state resonate shape in 11 generations.	(cross and box pattern)

ØØØ / Ø / Ø	"Glider". Resonant shape that moves itself 1 cell diagonally every 4 generations.	(0) (1) (2)

(3) (4)   direction of movement   --›

12
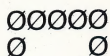
```
ØØØØØ
Ø   Ø
```
Becomes "Pulsar", a big 3-cycle resonant shape, in 33 generations. One of the 3 states shown here:

```
      ØØ          ØØ
      ØØ          ØØ
 Ø    Ø Ø      Ø Ø    Ø
 ØØØ  ØØ          ØØ  ØØØ
  Ø Ø Ø            Ø Ø Ø
      ØØØ        ØØØ

      ØØØ        ØØØ
 Ø  Ø Ø            Ø Ø  Ø
 ØØØ  ØØ          ØØ  ØØØ
 Ø    Ø Ø      Ø Ø    Ø
      ØØ          ØØ
      ØØ          ØØ
```

```
Ø           Ø
 ØØ ØØ
Ø           Ø
```
Becomes a "Pentadencathalon", a 15 (count 'em) cycle resonant shape. 2 of the 15 states shown here:

```
      Ø        Ø
 ØØ ØØØØ ØØ
      Ø        Ø
```

&

```
      ØØ
     Ø  Ø
    Ø      Ø
   Ø        Ø
   Ø        Ø
   Ø        Ø
    Ø      Ø
     Ø  Ø
      ØØ
```
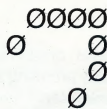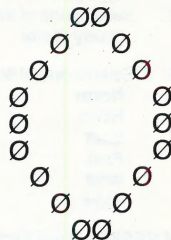
```
 ØØØØ
Ø    Ø
     Ø
Ø
```
"Light Spaceship". Moves itself across the universe 1 cell every 2 generations. Flips every other generation.

```
 ØØ            Ø  Ø
ØØØØ          Ø
ØØ ØØ   &     Ø      Ø
 ØØ           ØØØØ
```
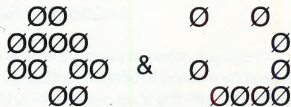
— ‣ direction of movement
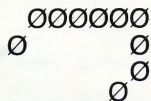
```
ØØØØØØ
Ø     Ø
      Ø
 Ø
```
"Heavy Spaceship". Bigger version of spaceship. Same properties.

```
        ØØ
 ØØØØ      Ø      Ø
ØØØØØØ              Ø
ØØØØ ØØ   Ø         Ø
  ØØ       ØØØØØØ
```
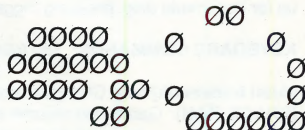
— ‣ direction of movement

Note that the "glider" and both "spaceships" can be aimed into the opponent's territory, and can bash into you opponent's formations, disrupting them, and perhaps starting a colony of your species deep in the opponent's territory. Remember also that these seed patterns only work as described if they are isolated. If other live cells get close enough, the patterns become disrupted.

Summary of Rules and Commands

LAWS OF UNIVERSE:

Rule 1: 2 or 3 neighbors survives
Rule 2: Exactly 3 neighbors creates new live cell
Rule 3: Majority of 3 neighbors determines species of new cell

RULES OF GAME:

Object: To be the species that most successfully populates the universe.
Winner: Side with highest population (score) when shot clock hits bottom, or when opposite side's population becomes zero (shut-out).

Set up: At start, shot clock counts up. Both sides input initial seed pattern. When shot clock reaches top, play begins.

Play: Shot clock counts down, and seed patterns evolve. Players may add one seed pattern per generation (as long as sufficient seed cells remain). When either player adds cells, shot clock is reset to top. BONUS: In each generation where a species' score is 1000 or more, a bonus seed is awarded (unless it already has the maximum of 99 left). Note that Study Mode has no border or shot clock, start with [RETURN].

CONSOLE KEYS: (Note: all of below keys will erase current game)

START: Starts play of current game/option selection.
SELECT: Selects one of three games:
Study Mode   One Cell Game   Seed List Game

OPTION: Selects one of six options:

Norm	Normal speed, 99 seeds per side
Hcap	Normal speed, 0-99 seeds per side (user's choice)
Wall	Like Norm, without "wrap-around" universe
Fast	Fast shot clock, 50 seeds per side
Wild	Like Fast, with an occasional "wild" generation.
Slow	Slow speed, 99 seeds per side

SYSTEM RESET: Plays Fanfare, and waits for Game option select.
JOYSTICKS: Joystick 1 = Left side
Joystick 2 = Right side

Cursor will move in same direction as joystick (until edge). In Seed List Game, the "menu" area is accessed by moving to bottom, letting go stick, and then press towards bottom again. Leave by pressing towards top, with the lit up cursor being the new seed shape. Pressing trigger while in play area seed rotates or flips seed shape. Pressing trigger while in play area plants seed shape (if enough seed cells available). Your seeds will overwrite other side's cells, but not your own. With single-cell seed, and in set-up (or halt) mode only, pressing trigger second time before moving cursor will erase seed cell.

KEYBOARD COMMANDS: The following keys are defined:

[Atari trademark] key: Changes screen colors, anytime (32 flavors).
[SPACE BAR]: Game halt/resume key. While halted, seeds may be added as in "set-up" mode. If pressed during "set-up", play starts immediately.
[RETURN] key: Single step halt/resume. Same as space bar, except only one generation is computed, then the game is again halted.
[ESC] key: Game continuation key. Operates only after end of game (while winner flashes). Restarts game without erasing screen. Both sides have their original seed quota restored.
Number keys (1,2,3,4,5,6,7,8,9,0): At begining of HCAP (handicap) option only, are used to enter the quota of seed cells for each player.

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